1001134084093001

Federal Communications Commission
Washington, D. C. 20554

Approved by OMB
3060-0627
Expires 01/31/98

FOR FCC USE ONLY

FCC 302-AM
APPLICATION FOR AM BROADCAST STATION LICENSE

(Please read instructions before filling out form.

FOR COMMISSION USE ONLY
FILE NO. BMML-20100112AEQ

SECTION I - APPLICANT FEE INFORMATION

1. PAYOR NAME (Last, First, Middle Initial)

DONALD A AND SHARON E. WIEDEMAN

MAILING ADDRESS (Line 1) (Maximum 35 characters)
26886 W.C.R. 17

MAILING ADDRESS (Line 2) (Maximum 35 characters)

CITY	STATE OR COUNTRY (if foreign address)	ZIP CODE
JOHNSTOWN	CO	80534

TELEPHONE NUMBER (include area code)	CALL LETTERS	OTHER FCC IDENTIFIER (If applicable)
970-587-5175	KHNC	17183

2. A. Is a fee submitted with this application? [✔] Yes [ ] No

B. If No, indicate reason for fee exemption (see 47 C.F.R. Section

[ ] Governmental Entity [ ] Noncommercial educational licensee [ ] Other (Please explain):

C. If Yes, provide the following information:

Enter in Column (A) the correct Fee Type Code for the service you are applying for. Fee Type Codes may be found in the "Mass Media Services Fee Filing Guide." Column (B) lists the Fee Multiple applicable for this application. Enter fee amount due in Column (C).

(A) FEE TYPE CODE	(B) FEE MULTIPLE	(C) FEE DUE FOR FEE TYPE CODE IN COLUMN (A)	FOR FCC USE ONLY
M M R	0 0 0 1	$ 615.00	

To be used only when you are requesting concurrent actions which result in a requirement to list more than one Fee Type Code.

(A)	(B)	(C)	FOR FCC USE ONLY
	0 0 0 1	$ 705.00	

ADD ALL AMOUNTS SHOWN IN COLUMN C, AND ENTER THE TOTAL HERE. THIS AMOUNT SHOULD EQUAL YOUR ENCLOSED REMITTANCE.

TOTAL AMOUNT REMITTED WITH THIS APPLICATION	FOR FCC USE ONLY
$ 1320.00	

SECTION II - APPLICANT INFORMATION		
1. NAME OF APPLICANT DONALD A. AND SHARON E. WIEDEMAN		
MAILING ADDRESS 26886 WELD COUNTY ROAD 17		
CITY JOHNSTOWN	STATE CO	ZIP CODE 80534

2. This application is for:

☑ Commercial ☐ Noncommercial

☑ AM Directional ☐ AM Non-Directional

Call letters	Community of License	Construction Permit File No.	Modification of Construction Permit File No(s).	Expiration Date of Last Construction Permit
KHNC	JOHNSTOWN	BP20040825AAT		12/07/2007

3. Is the station now operating pursuant to automatic program test authority in accordance with 47 C.F.R. Section 73.1620?

☑ Yes ☐ No

If No, explain in an Exhibit.

Exhibit No.

4. Have all the terms, conditions, and obligations set forth in the above described construction permit been fully met?

☑ Yes ☐ No

If No, state exceptions in an Exhibit.

Exhibit No.

5. Apart from the changes already reported, has any cause or circumstance arisen since the grant of the underlying construction permit which would result in any statement or representation contained in the construction permit application to be now incorrect?

☐ Yes ☑ No

If Yes, explain in an Exhibit.

Exhibit No.

6. Has the permittee filed its Ownership Report (FCC Form 323) or ownership certification in accordance with 47 C.F.R. Section 73.3615(b)?

☐ Yes ☐ No

☑ Does not apply

If No, explain in an Exhibit.

Exhibit No.

7. Has an adverse finding been made or an adverse final action been taken by any court or administrative body with respect to the applicant or parties to the application in a civil or criminal proceeding, brought under the provisions of any law relating to the following: any felony; mass media related antitrust or unfair competition; fraudulent statements to another governmental unit; or discrimination?

☐ Yes ☑ No

If the answer is Yes, attach as an Exhibit a full disclosure of the persons and matters involved, including an identification of the court or administrative body and the proceeding (by dates and file numbers), and the disposition of the litigation. Where the requisite information has been earlier disclosed in connection with another application or as required by 47 U.S.C. Section 1.65(c), the applicant need only provide: (i) an identification of that previous submission by reference to the file number in the case of an application, the call letters of the station regarding which the application or Section 1.65 information was filed, and the date of filing; and (ii) the disposition of the previously reported matter.

Exhibit No.

8. Does the applicant, or any party to the application, have a petition on file to migrate to the expanded band (1605-1705 kHz) or a permit or license either in the existing band or expanded band that is held in combination (pursuant to the 5 year holding period allowed) with the AM facility proposed to be modified herein?

☐ Yes ☑ No

If Yes, provide particulars as an Exhibit.

Exhibit No.

The APPLICANT hereby waives any claim to the use of any particular frequency or of the electromagnetic spectrum as against the regulatory power of the United States because use of the same, whether by license or otherwise, and requests and authorization in accordance with this application. (See Section 304 of the Communications Act of 1934, as amended).

The APPLICANT acknowledges that all the statements made in this application and attached exhibits are considered material representations and that all the exhibits are a material part hereof and are incorporated herein as set out in full in

CERTIFICATION

1. By checking Yes, the applicant certifies, that, in the case of an individual applicant, he or she is not subject to a denial of federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. Section 862, or, in the case of a non-individual applicant (e.g., corporation, partnership or other unincorporated association), no party to the application is subject to a denial of federal benefits that includes FCC benefits pursuant to that section. For the definition of a "party" for these purposes, see 47 C.F.R. Section 1.2002(b).

☑ Yes ☐ No

2. I certify that the statements in this application are true, complete, and correct to the best of my knowledge and belief, and are made in good faith.

Name	Signature	
Donald A. Wiedeman Sharon E. Wiedeman	Donald A Wiedeman Sharon E. Wiedeman	
Title	Date	Telephone Number
Owners	January 8, 2010	970-587-5175

WILLFUL FALSE STATEMENTS ON THIS FORM ARE PUNISHABLE BY FINE AND/OR IMPRISONMENT (U.S. CODE, TITLE 18, SECTION 1001), AND/OR REVOCATION OF ANY STATION LICENSE OR CONSTRUCTION

FCC NOTICE TO INDIVIDUALS REQUIRED BY THE PRIVACY ACT AND THE PAPERWORK REDUCTION ACT

The solicitation of personal information requested in this application is authorized by the Communications Act of 1934, as amended. The Commission will use the information provided in this form to determine whether grant of the application is in the public interest. In reaching that determination, or for law enforcement purposes, it may become necessary to refer personal information contained in this form to another government agency. In addition, all information provided in this form will be available for public inspection. If information requested on the form is not provided, the application may be returned without action having been taken upon it or its processing may be delayed while a request is made to provide the missing information. Your response is required to obtain the requested authorization.

Public reporting burden for this collection of information is estimated to average 639 hours and 53 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, can be sent to the Federal Communications Commission, Records Management Branch, Paperwork Reduction Project (3060-0627), Washington, D. C. 20554. Do NOT send completed forms to this address.

THE FOREGOING NOTICE IS REQUIRED BY THE PRIVACY ACT OF 1974, P.L. 93-579, DECEMBER 31, 1974, 5 U.S.C. 552a(e)(3), AND THE PAPERWORK REDUCTION ACT OF 1980, P.L. 96-511, DECEMBER 11, 1980, 44 U.S.C. 3507.

SECTION III - LICENSE APPLICATION ENGINEERING DATA

Name of Applicant

DONALD A. & SHARON E. WIEDEMAN

PURPOSE OF AUTHORIZATION APPLIED FOR: (check one)

☑ Station License ☐ Direct Measurement of Power

1. Facilities authorized in construction permit					
Call Sign	File No. of Construction Permit (if applicable)	Frequency (kHz)	Hours of Operation	Power in kilowatts	
				Night	Day
KHNC	BP20040825AAT	1360	UNLIMITED	1	10

2. Station location	
State	City or Town
COLORADO	JOHNSTOWN

3. Transmitter location			
State	County	City or Town	Street address (or other identification)
CO	WELD	JOHNSTOWN	26886 WCR 17

4. Main studio location			
State	County	City or Town	Street address (or other identification)
CO	WELD	JOHNSTOWN	2 S. PARISH AVE.

5. Remote control point location (specify only if authorized directional antenna)			
State	County	City or Town	Street address (or other identification)
CO	WELD	JOHNSTOWN	2 S. PARISH AVE.

6. Has type-approved stereo generating equipment been installed? ☐ Yes ☑ No

7. Does the sampling system meet the requirements of 47 C.F.R. Section 73.68? ☑ Yes ☐ No ☐ Not Applicable

Attach as an Exhibit a detailed description of the sampling system as installed. Exhibit No.

8. Operating constants:	
RF common point or antenna current (in amperes) without modulation for night system: 4.65	RF common point or antenna current (in amperes) without modulation for day system: 22.9
Measured antenna or common point resistance (in ohms) at operating frequency — Night: 50 Day: 19	Measured antenna or common point reactance (in ohms) at operating frequency — Night: 0 Day: -J32

Antenna indications for directional operation

Towers	Antenna monitor Phase reading(s) in degrees		Antenna monitor sample current ratio(s)		Antenna base currents	
	Night	Day	Night	Day	Night	Day
1 NORTH	-161		0.655			
2 CENTER	0.0 REF		1.00 REF			
3 SOUTH	+152.8		0.535			

Manufacturer and type of antenna monitor: POTOMAC INSTRUMENTS AM19 (TYPE 204)

9. Description of antenna system ((f directional antenna is used, the information requested below should be given for each element of the array. Use separate sheets if necessary.)

Type Radiator	Overall height in meters of radiator above base insulator, or above base, if grounded.	Overall height in meters above ground (without obstruction lighting)	Overall height in meters above ground (include obstruction lighting)	If antenna is either top loaded or sectionalized, describe fully in an Exhibit.
GUYED TOWER	SEE ENG STMT	SEE ENG STMT	SEE ENG STMT	Exhibit No.

Excitation ☑ Series ☐ Shunt

Geographic coordinates to nearest second. For directional antenna give coordinates of center of array. For single vertical radiator give tower location.

North Latitude	40	°	23	'	11	"	West Longitude	104	°	54	'	19	"

If not fully described above, attach as an Exhibit further details and dimensions including any other antenna mounted on tower and associated isolation circuits. Exhibit No.

Also, if necessary for a complete description, attach as an Exhibit a sketch of the details and dimensions of ground system. Exhibit No.

10. In what respect, if any, does the apparatus constructed differ from that described in the application for construction permit or in the permit?

NONE

11. Give reasons for the change in antenna or common point resistance.

I certify that I represent the applicant in the capacity indicated below and that I have examined the foregoing statement of technical information and that it is true to the best of my knowledge and belief.

Name (Please Print or Type)	Signature (check appropriate box below)
TIMOTHY C CUTFORTH	Timothy C Cutforth
Address (include ZIP Code) VIR JAMES ENGINEERS 965 S. IRVING STREET DENVER, CO 80219	Date January 4, 2010 Telephone No. (Include Area Code) 303-937-1900

☐ Technical Director

☑ Registered Professional Engineer

☐ Chief Operator

☐ Technical Consultant

☐ Other (specify)

VIR JAMES P. C.
TIMOTHY C. CUTFORTH P.E., DIRECTOR OF ENGINEERING
BROADCAST ENGINEERING CONSULTANTS
965 S. IRVING ST. · DENVER, CO · 80219
(303) 937-1900

EXHIBIT E-1

APPLICATION FOR LICENSE INFORMATION
RADIO STATION KHNC
JOHNSTOWN, COLORADO

DON AND SHARON WIEDEMAN

January 8, 2010

1360 kHz 10 kW-D/1 kW-N DA-N

EXECUTIVE SUMMARY

This engineering exhibit supports an application for modification of license for the existing nighttime directional antenna system of radio station KHNC in Johnstown, Colorado (FCC FID No. 17183) pursuant to the recently enacted AM technical rules permitting moment-method modeling of eligible AM directional arrays.

KHNC operates on 1360 kHz and has been operating pursuant to the terms of its license (BL-20061012ACY). The instant application Proposes only to change to Method of Moment (MoM) proof of performance for the KHNC nighttime array. No changes have been made or proposed to the night site or antenna or to the day or night operating system previously described.

Information is provided herein showing that the directional antenna parameters for the nighttime pattern authorized by the FCC have been determined in accordance with the requirements of 47 C.F.R. §73.151(c). The system has been adjusted to produce antenna monitor parameters within ±5 percent in ratio and ±3 degrees in phase of the modeled values, as required by the Rules. A modified station license is requested herewith specifying the new nighttime operating parameters.

Analysis of Tower Impedance Measurements to Verify Method of Moments Model

Tower base impedance measurements were made at the final J-plugs within the Antenna Tuning Units (ATUs) using a Delta OIB-1 impedance bridge. The other towers were all open-circuited at the same points where the impedance measurements were made for them. The static drain chokes at the ATU outputs were disconnected from all towers during the base impedance measurements. This arrangement left only the short feed tubing between the ATU outputs and the tower base in series in the impedance measurements.

ACSModel (MININEC 3.1 core) was used to model the KHNC nighttime array.

A lumped load with a reactance of –j10,000 was modeled at the base of the other towers to simulate an open circuit at each tower base.

Towers 1 and 3 are physically 60m tall (61m overall AGL) for an electrical height of 98 degrees and tower 2 is 42.9m tall (44m overall AGL) for an electrical height of 70 degrees.

The tower heights were adjusted in the model in order to achieve calibration of the model with the measured base impedances. All modeled tower heights were within 75 to 125 percent of the physical tower height as required by the FCC Rules.

The radius for each tower is the physical radius of the tower as determined by the formula $3T/2\pi$, where T is the tower face width in meters. The KHNC radiators are uniform cross-section triangular towers and have face widths of 0.381 meters. Although the tower radius computes to 0.182 meters the model was adjusted to 0.194 meters radius for all three towers which is within the tolerance allowed in the FCC rules.

Each tower is fed with a short length of large-diameter copper tubing that exhibits a small amount of series inductive reactance. This tubing connects to each tower immediately above the base insulator.

The tower measured reactances differ significantly due to significantly different ATU mounting locations relative to the tower base pier. Tower 2 ATU is also elevated so that the input to the bowl insulator is located higher than the other two ATU's and with a larger diameter feed tubing resulting in a higher series inductance. The model calibration process was able to compensate for these differences well within the allowable tolerances specified in the rules.

A circuit model was constructed for each tower using the assumed series feed tubing and ignoring the relatively small shunt capacitance of the base insulator as allowed in the rules. This model was used with the Westberg Circuit Analysis Program (WCAP) to determine the effects of these reactances on the ATU output impedance at each tower. In each of the WCAP tabulations, node 2 represents the ATU output reference point and node 3 represents the tower base. Node 0 represents ground potential. The ATU output impedances can be found in the "TO NODE IMPEDANCE" column of each WCAP tabulation, following the phantom 1.0 ohm resistor inserted in the model to provide a calculation point for the impedance. The complex base impedance of each tower from the moment method model is represented in each case by the complex load from node 3 to ground. The WCAP circuit model tabulation immediately follows the model for each tower.

§73.151(c)(1)(vii) permits the use of a lumped series inductance of 10 uH or less between the output port of each antenna tuning unit and the associated tower. In each case, the value of lumped series inductance was below this 10 uH limit.

The modeled and measured impedances at the ATU output J-plugs with the other towers open-circuited at their ATU output J-plugs agree within ±2 ohms and ±4 percent as required by the FCC rules.

Table 1 – Analysis of Tower Impedance Measurements to Verify Moment Method Model

Twr.	Z_{BASE} (Modeled)	Z_{ATU} (Modeled)	Z_{ATU} (Measured)	Series L (uH)		Phys. Height (deg.)	Model Height (deg.)	% Phys. Height
1	70.3 +j99.2	70.3 +j119	70.0 +j119	2.32		98.0	103.4	105.5
2	19.9 –j70.7	19.9 –j31.0	20.0 –j31	4.65		70.0	72.0	102.9
3	69.2 +j96.7	69.2 +j126	69.0 +j126	3.43		98.0	103.0	105.1

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**************************************
ACSModel
(MININEC 3.1 Core)
12-14-2009 15:15:53
**************************************

KHNC  Tower 1 driven and Towers 2 & 3 floated


Frequency = 1.360 MHz     Wavelength = 220.44117 Meters

No. of Wires: 3

Wire No. 1   Coordinates                                  End          No. of
   X             Y             Z          Radius     Connection
Segments
 0             0             0                         -1
 0             0             63.31561     0.194         0              20

Wire No. 2   Coordinates                                  End          No. of
   X             Y             Z          Radius     Connection
Segments
-79.40984     -5.552877     0                         -2
-79.40984     -5.552877     44.08823     0.194         0              20

Wire No. 3   Coordinates                                  End          No. of
   X             Y             Z          Radius     Connection
Segments
-159.1833     -2.778554     0                         -3
-159.1833     -2.778554     63.07067     0.194         0              20

                **** ANTENNA GEOMETRY ****

Wire No.  1  Coordinates                                  Connection  Pulse
X             Y             Z             Radius        End1 End2   No.
 0             0             0             0.194         -1   1      1
 0             0             3.16578       0.194         1    1      2
 0             0             6.331561      0.194         1    1      3
 0             0             9.49734       0.194         1    1      4
 0             0             12.66312      0.194         1    1      5
 0             0             15.8289       0.194         1    1      6
 0             0             18.99468      0.194         1    1      7
 0             0             22.16046      0.194         1    1      8
 0             0             25.32624      0.194         1    1      9
 0             0             28.49202      0.194         1    1      10
 0             0             31.6578       0.194         1    1      11
 0             0             34.82359      0.194         1    1      12
 0             0             37.98936      0.194         1    1      13
 0             0             41.15514      0.194         1    1      14
 0             0             44.32092      0.194         1    1      15
 0             0             47.4867       0.194         1    1      16
 0             0             50.65248      0.194         1    1      17
 0             0             53.81826      0.194         1    1      18
 0             0             56.98405      0.194         1    1      19
 0             0             60.14982      0.194         1    0      20
```

Wire No. 2 Coordinates

X	Y	Z	Radius	Connection End1	Connection End2	Pulse No.
-79.40984	-5.552877	0	0.194	-2	2	21
-79.40984	-5.552877	2.204412	0.194	2	2	22
-79.40984	-5.552877	4.408823	0.194	2	2	23
-79.40984	-5.552877	6.613235	0.194	2	2	24
-79.40984	-5.552877	8.817647	0.194	2	2	25
-79.40984	-5.552877	11.02206	0.194	2	2	26
-79.40984	-5.552877	13.22647	0.194	2	2	27
-79.40984	-5.552877	15.43088	0.194	2	2	28
-79.40984	-5.552877	17.63529	0.194	2	2	29
-79.40984	-5.552877	19.8397	0.194	2	2	30
-79.40984	-5.552877	22.04412	0.194	2	2	31
-79.40984	-5.552877	24.24853	0.194	2	2	32
-79.40984	-5.552877	26.45294	0.194	2	2	33
-79.40984	-5.552877	28.65735	0.194	2	2	34
-79.40984	-5.552877	30.86176	0.194	2	2	35
-79.40984	-5.552877	33.06617	0.194	2	2	36
-79.40984	-5.552877	35.27059	0.194	2	2	37
-79.40984	-5.552877	37.475	0.194	2	2	38
-79.40984	-5.552877	39.67941	0.194	2	2	39
-79.40984	-5.552877	41.88382	0.194	2	0	40

Wire No. 3 Coordinates

X	Y	Z	Radius	Connection End1	Connection End2	Pulse No.
-159.1833	-2.778554	0	0.194	-3	3	41
-159.1833	-2.778554	3.153533	0.194	3	3	42
-159.1833	-2.778554	6.307067	0.194	3	3	43
-159.1833	-2.778554	9.4606	0.194	3	3	44
-159.1833	-2.778554	12.61413	0.194	3	3	45
-159.1833	-2.778554	15.76767	0.194	3	3	46
-159.1833	-2.778554	18.9212	0.194	3	3	47
-159.1833	-2.778554	22.07473	0.194	3	3	48
-159.1833	-2.778554	25.22827	0.194	3	3	49
-159.1833	-2.778554	28.3818	0.194	3	3	50
-159.1833	-2.778554	31.53534	0.194	3	3	51
-159.1833	-2.778554	34.68887	0.194	3	3	52
-159.1833	-2.778554	37.8424	0.194	3	3	53
-159.1833	-2.778554	40.99593	0.194	3	3	54
-159.1833	-2.778554	44.14947	0.194	3	3	55
-159.1833	-2.778554	47.303	0.194	3	3	56
-159.1833	-2.778554	50.45654	0.194	3	3	57
-159.1833	-2.778554	53.61007	0.194	3	3	58
-159.1833	-2.778554	56.7636	0.194	3	3	59
-159.1833	-2.778554	59.91714	0.194	3	0	60

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 1, 100.0, 0.0

Number of Loads: 2
Pulse No., Resistance, Reactance: 21 , 0 ,-10000
Pulse No., Resistance, Reactance: 41 , 0 ,-10000

********** SOURCE DATA **********
Pulse 1 Voltage = (100.0, 0.0j)
Current = (0.4759, -0.6709j)
Impedance = (70.332, 99.164j)
Power = 23.79 Watts

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KHNC-1.CIR

I	1.0000	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	2.3200	2	3	.0000	.0000	.0000
R	70.3000	3	0	99.2000	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.360

NODE	VOLT MAG	VOLT PHASE
1	138.7464	59.0769
2	138.2352	59.4325
3	121.5843	54.6760

				BRANCH VOLTAGE		BRANCH CURRENT	FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
VSWR											
R	1-	2	1.000	1.00	.000	1.00	.000	71.30	119.02	70.30	119.02
L	2-	3	2.320	19.82	90.000	1.00	.000	70.30	119.02	70.30	99.20
R	3-	0	70.300	121.58	54.676	1.00	.000	70.30	99.20	.00	.00

****
ACSModel
(MININEC 3.1 Core)
12-14-2009 15:14:29
****

KHNC Tower 2 driven and Towers 1 & 3 floated

Frequency = 1.360 MHz Wavelength = 220.44117 Meters

No. of Wires: 3

Wire No. 1 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
0	0	0		-1	
0	0	63.31561	0.194	0	20

Wire No. 2 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
-79.40984	-5.552877	0		-2	
-79.40984	-5.552877	44.08823	0.194	0	20

Wire No. 3 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
-159.1833	-2.778554	0		-3	
-159.1833	-2.778554	63.07067	0.194	0	20

**** ANTENNA GEOMETRY ****

Wire No. 1 Coordinates X	Y	Z	Radius	Connection End1	End2	Pulse No.
0	0	0	0.194	-1	1	1
0	0	3.16578	0.194	1	1	2
0	0	6.331561	0.194	1	1	3
0	0	9.49734	0.194	1	1	4
0	0	12.66312	0.194	1	1	5
0	0	15.8289	0.194	1	1	6
0	0	18.99468	0.194	1	1	7
0	0	22.16046	0.194	1	1	8
0	0	25.32624	0.194	1	1	9
0	0	28.49202	0.194	1	1	10
0	0	31.6578	0.194	1	1	11
0	0	34.82359	0.194	1	1	12
0	0	37.98936	0.194	1	1	13
0	0	41.15514	0.194	1	1	14
0	0	44.32092	0.194	1	1	15
0	0	47.4867	0.194	1	1	16
0	0	50.65248	0.194	1	1	17
0	0	53.81826	0.194	1	1	18
0	0	56.98405	0.194	1	1	19
0	0	60.14982	0.194	1	0	20

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-79.40984	-5.552877	0	0.194	-2	2	21
-79.40984	-5.552877	2.204412	0.194	2	2	22
-79.40984	-5.552877	4.408823	0.194	2	2	23
-79.40984	-5.552877	6.613235	0.194	2	2	24
-79.40984	-5.552877	8.817647	0.194	2	2	25
-79.40984	-5.552877	11.02206	0.194	2	2	26
-79.40984	-5.552877	13.22647	0.194	2	2	27
-79.40984	-5.552877	15.43088	0.194	2	2	28
-79.40984	-5.552877	17.63529	0.194	2	2	29
-79.40984	-5.552877	19.8397	0.194	2	2	30
-79.40984	-5.552877	22.04412	0.194	2	2	31
-79.40984	-5.552877	24.24853	0.194	2	2	32
-79.40984	-5.552877	26.45294	0.194	2	2	33
-79.40984	-5.552877	28.65735	0.194	2	2	34
-79.40984	-5.552877	30.86176	0.194	2	2	35
-79.40984	-5.552877	33.06617	0.194	2	2	36
-79.40984	-5.552877	35.27059	0.194	2	2	37
-79.40984	-5.552877	37.475	0.194	2	2	38
-79.40984	-5.552877	39.67941	0.194	2	2	39
-79.40984	-5.552877	41.88382	0.194	2	0	40

Wire No. 3 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-159.1833	-2.778554	0	0.194	-3	3	41
-159.1833	-2.778554	3.153533	0.194	3	3	42
-159.1833	-2.778554	6.307067	0.194	3	3	43
-159.1833	-2.778554	9.4606	0.194	3	3	44
-159.1833	-2.778554	12.61413	0.194	3	3	45
-159.1833	-2.778554	15.76767	0.194	3	3	46
-159.1833	-2.778554	18.9212	0.194	3	3	47
-159.1833	-2.778554	22.07473	0.194	3	3	48
-159.1833	-2.778554	25.22827	0.194	3	3	49
-159.1833	-2.778554	28.3818	0.194	3	3	50
-159.1833	-2.778554	31.53534	0.194	3	3	51
-159.1833	-2.778554	34.68887	0.194	3	3	52
-159.1833	-2.778554	37.8424	0.194	3	3	53
-159.1833	-2.778554	40.99593	0.194	3	3	54
-159.1833	-2.778554	44.14947	0.194	3	3	55
-159.1833	-2.778554	47.303	0.194	3	3	56
-159.1833	-2.778554	50.45654	0.194	3	3	57
-159.1833	-2.778554	53.61007	0.194	3	3	58
-159.1833	-2.778554	56.7636	0.194	3	3	59
-159.1833	-2.778554	59.91714	0.194	3	0	60

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 21, 100.0, 0.0

Number of Loads: 2
Pulse No., Resistance, Reactance: 1 , 0 ,-10000
Pulse No., Resistance, Reactance: 41 , 0 ,-10000

********** SOURCE DATA **********
Pulse 21 Voltage = (100.0, 0.0j)
Current = (0.369, 1.3099j)
Impedance = (19.923, -70.732j)
Power = 18.45 Watts

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KHNC-2.CIR

I	1.0000	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.6500	2	3	.0000	.0000	.0000
R	19.9000	3	0	-70.7000	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.360

NODE	VOLT MAG	VOLT PHASE
1	37.3584	-55.9825
2	36.8083	-57.2728
3	73.4473	-74.2796

				BRANCH VOLTAGE		BRANCH CURRENT	FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
VSWR											
R	1-	2	1.000	1.00	.000	1.00	.000	20.90	-30.97	19.90	-30.97
L	2-	3	4.650	39.73	90.000	1.00	.000	19.90	-30.97	19.90	-70.70
R	3-	0	19.900	73.45	-74.280	1.00	.000	19.90	-70.70	.00	.00

****

ACSModel
(MININEC 3.1 Core)
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****

KHNC Tower 3 driven and Towers 1 & 2 floated

Frequency = 1.360 MHz Wavelength = 220.44117 Meters

No. of Wires: 3

Wire No. 1 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
0	0	0		-1	
0	0	63.31561	0.194	0	20

Wire No. 2 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
-79.40984	-5.552877	0		-2	
-79.40984	-5.552877	44.08823	0.194	0	20

Wire No. 3 Coordinates X	Y	Z	Radius	End Connection	No. of Segments
-159.1833	-2.778554	0		-3	
-159.1833	-2.778554	63.07067	0.194	0	20

**** ANTENNA GEOMETRY ****

Wire No. 1 Coordinates X	Y	Z	Radius	Connection End1	End2	Pulse No.
0	0	0	0.194	-1	1	1
0	0	3.16578	0.194	1	1	2
0	0	6.331561	0.194	1	1	3
0	0	9.49734	0.194	1	1	4
0	0	12.66312	0.194	1	1	5
0	0	15.8289	0.194	1	1	6
0	0	18.99468	0.194	1	1	7
0	0	22.16046	0.194	1	1	8
0	0	25.32624	0.194	1	1	9
0	0	28.49202	0.194	1	1	10
0	0	31.6578	0.194	1	1	11
0	0	34.82359	0.194	1	1	12
0	0	37.98936	0.194	1	1	13
0	0	41.15514	0.194	1	1	14
0	0	44.32092	0.194	1	1	15
0	0	47.4867	0.194	1	1	16
0	0	50.65248	0.194	1	1	17
0	0	53.81826	0.194	1	1	18
0	0	56.98405	0.194	1	1	19
0	0	60.14982	0.194	1	0	20

Wire No. 2 Coordinates

X	Y	Z	Radius	Connection End1	Connection End2	Pulse No.
-79.40984	-5.552877	0	0.194	-2	2	21
-79.40984	-5.552877	2.204412	0.194	2	2	22
-79.40984	-5.552877	4.408823	0.194	2	2	23
-79.40984	-5.552877	6.613235	0.194	2	2	24
-79.40984	-5.552877	8.817647	0.194	2	2	25
-79.40984	-5.552877	11.02206	0.194	2	2	26
-79.40984	-5.552877	13.22647	0.194	2	2	27
-79.40984	-5.552877	15.43088	0.194	2	2	28
-79.40984	-5.552877	17.63529	0.194	2	2	29
-79.40984	-5.552877	19.8397	0.194	2	2	30
-79.40984	-5.552877	22.04412	0.194	2	2	31
-79.40984	-5.552877	24.24853	0.194	2	2	32
-79.40984	-5.552877	26.45294	0.194	2	2	33
-79.40984	-5.552877	28.65735	0.194	2	2	34
-79.40984	-5.552877	30.86176	0.194	2	2	35
-79.40984	-5.552877	33.06617	0.194	2	2	36
-79.40984	-5.552877	35.27059	0.194	2	2	37
-79.40984	-5.552877	37.475	0.194	2	2	38
-79.40984	-5.552877	39.67941	0.194	2	2	39
-79.40984	-5.552877	41.88382	0.194	2	0	40

Wire No. 3 Coordinates

X	Y	Z	Radius	Connection End1	Connection End2	Pulse No.
-159.1833	-2.778554	0	0.194	-3	3	41
-159.1833	-2.778554	3.153533	0.194	3	3	42
-159.1833	-2.778554	6.307067	0.194	3	3	43
-159.1833	-2.778554	9.4606	0.194	3	3	44
-159.1833	-2.778554	12.61413	0.194	3	3	45
-159.1833	-2.778554	15.76767	0.194	3	3	46
-159.1833	-2.778554	18.9212	0.194	3	3	47
-159.1833	-2.778554	22.07473	0.194	3	3	48
-159.1833	-2.778554	25.22827	0.194	3	3	49
-159.1833	-2.778554	28.3818	0.194	3	3	50
-159.1833	-2.778554	31.53534	0.194	3	3	51
-159.1833	-2.778554	34.68887	0.194	3	3	52
-159.1833	-2.778554	37.8424	0.194	3	3	53
-159.1833	-2.778554	40.99593	0.194	3	3	54
-159.1833	-2.778554	44.14947	0.194	3	3	55
-159.1833	-2.778554	47.303	0.194	3	3	56
-159.1833	-2.778554	50.45654	0.194	3	3	57
-159.1833	-2.778554	53.61007	0.194	3	3	58
-159.1833	-2.778554	56.7636	0.194	3	3	59
-159.1833	-2.778554	59.91714	0.194	3	0	60

Sources: 1
Pulse No., Voltage Magnitude, Phase (Degrees): 41, 100.0, 0.0

Number of Loads: 2
Pulse No., Resistance, Reactance: 1 , 0 ,-10000
Pulse No., Resistance, Reactance: 21 , 0 ,-10000

********** SOURCE DATA **********
Pulse 41 Voltage = (100.0, 0.0j)
Current = (0.4897, -0.684j)
Impedance = (69.2, 96.661j)
Power = 24.48 Watts

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KHNC-3.CIR

I	1.0000	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	3.4300	2	3	.0000	.0000	.0000
R	69.2000	3	0	96.7000	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.360

NODE	VOLT MAG	VOLT PHASE
1	144.2446	60.8778
2	143.7606	61.2260
3	118.9098	54.4119

				BRANCH VOLTAGE		BRANCH CURRENT	FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
				MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
VSWR											
R	1-	2	1.000	1.00	.000	1.00	.000	70.20	126.01	69.20	126.01
L	2-	3	3.430	29.31	90.000	1.00	.000	69.20	126.01	69.20	96.70
R	3-	0	69.200	118.91	54.412	1.00	.000	69.20	96.70	.00	.00

Derivation of Operating Parameters for Nighttime Directional Antenna

Once calibrated against the measured individual open-circuited base impedances, the moment method model was utilized for nighttime directional antenna calculations. These calculations were made to determine the complex voltage source values to be applied at ground level for each tower of the array to produce the current moment sums for the towers which, when normalized to the reference tower, equate to the theoretical field parameters of the authorized directional pattern. These voltage sources were then applied in the model and the tower currents were calculated.

Twenty segments were used for each tower. The KHNC towers are base sampled, which is permitted for towers of 120 electrical degrees or less. As such, the first (ground) segment of each tower was used to determine the model operating parameters of the array.

A circuit model was constructed to determine the effect of the series feed inductance, and shunt static drain choke reactance on the ATU output current. The static drain chokes are 630 microhenry and the circuit model for each tower is essentially the circuit model used for model verification above with the inductance of the static drain chokes added in and using the model-predicted operating impedance for each tower. Again, this model was used with the Westberg Circuit Analysis Program (WCAP).

This effect was, as expected, minimal, and the results are tabulated in the table below along with the base operating parameters for the nighttime array.

Twr.	Node	Current Magnitude (amperes)	Current Phase (degrees)	WCAP Current Offset for Unity I_{BASE}	WCAP Phase Offset for Unity $Ø_{BASE}$ (degrees)	Antenna Monitor Ratio	Antenna Monitor Phase (degrees)
1	1	4.2613	-158.75	1.0305	-0.69	0.655	-161.0
2	21	6.4905	+1.45	1.0015	-0.15	1.000	0.0
3	41	3.4709	154.54	1.0287	-0.16	0.535	+152.8

```
****************************************
                ACSModel
            (MININEC 3.1 Core)
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KHNC Night Directional parameters all three towers driven


Frequency = 1.360 MHz     Wavelength = 220.44117 Meters

No. of Wires: 3

Wire No. 1   Coordinates                                  End          No. of
   X             Y             Z          Radius      Connection
Segments
 0             0             0                          -1
 0             0             63.31561     0.194          0             20

Wire No. 2   Coordinates                                  End          No. of
   X             Y             Z          Radius      Connection
Segments
-79.40984     -5.552877     0                          -2
-79.40984     -5.552877     44.08823     0.194          0             20

Wire No. 3   Coordinates                                  End          No. of
   X             Y             Z          Radius      Connection
Segments
-159.1833     -2.778554     0                          -3
-159.1833     -2.778554     63.07067     0.194          0             20

                **** ANTENNA GEOMETRY ****

Wire No.  1  Coordinates                                  Connection  Pulse
X             Y             Z          Radius      End1  End2   No.
 0             0             0          0.194       -1    1      1
 0             0             3.16578    0.194       1     1      2
 0             0             6.331561   0.194       1     1      3
 0             0             9.49734    0.194       1     1      4
 0             0             12.66312   0.194       1     1      5
 0             0             15.8289    0.194       1     1      6
 0             0             18.99468   0.194       1     1      7
 0             0             22.16046   0.194       1     1      8
 0             0             25.32624   0.194       1     1      9
 0             0             28.49202   0.194       1     1      10
 0             0             31.6578    0.194       1     1      11
 0             0             34.82359   0.194       1     1      12
 0             0             37.98936   0.194       1     1      13
 0             0             41.15514   0.194       1     1      14
 0             0             44.32092   0.194       1     1      15
 0             0             47.4867    0.194       1     1      16
 0             0             50.65248   0.194       1     1      17
 0             0             53.81826   0.194       1     1      18
 0             0             56.98405   0.194       1     1      19
 0             0             60.14982   0.194       1     0      20
```

Wire No. 2 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-79.40984	-5.552877	0	0.194	-2	2	21
-79.40984	-5.552877	2.204412	0.194	2	2	22
-79.40984	-5.552877	4.408823	0.194	2	2	23
-79.40984	-5.552877	6.613235	0.194	2	2	24
-79.40984	-5.552877	8.817647	0.194	2	2	25
-79.40984	-5.552877	11.02206	0.194	2	2	26
-79.40984	-5.552877	13.22647	0.194	2	2	27
-79.40984	-5.552877	15.43088	0.194	2	2	28
-79.40984	-5.552877	17.63529	0.194	2	2	29
-79.40984	-5.552877	19.8397	0.194	2	2	30
-79.40984	-5.552877	22.04412	0.194	2	2	31
-79.40984	-5.552877	24.24853	0.194	2	2	32
-79.40984	-5.552877	26.45294	0.194	2	2	33
-79.40984	-5.552877	28.65735	0.194	2	2	34
-79.40984	-5.552877	30.86176	0.194	2	2	35
-79.40984	-5.552877	33.06617	0.194	2	2	36
-79.40984	-5.552877	35.27059	0.194	2	2	37
-79.40984	-5.552877	37.475	0.194	2	2	38
-79.40984	-5.552877	39.67941	0.194	2	2	39
-79.40984	-5.552877	41.88382	0.194	2	0	40

Wire No. 3 Coordinates				Connection		Pulse
X	Y	Z	Radius	End1	End2	No.
-159.1833	-2.778554	0	0.194	-3	3	41
-159.1833	-2.778554	3.153533	0.194	3	3	42
-159.1833	-2.778554	6.307067	0.194	3	3	43
-159.1833	-2.778554	9.4606	0.194	3	3	44
-159.1833	-2.778554	12.61413	0.194	3	3	45
-159.1833	-2.778554	15.76767	0.194	3	3	46
-159.1833	-2.778554	18.9212	0.194	3	3	47
-159.1833	-2.778554	22.07473	0.194	3	3	48
-159.1833	-2.778554	25.22827	0.194	3	3	49
-159.1833	-2.778554	28.3818	0.194	3	3	50
-159.1833	-2.778554	31.53534	0.194	3	3	51
-159.1833	-2.778554	34.68887	0.194	3	3	52
-159.1833	-2.778554	37.8424	0.194	3	3	53
-159.1833	-2.778554	40.99593	0.194	3	3	54
-159.1833	-2.778554	44.14947	0.194	3	3	55
-159.1833	-2.778554	47.303	0.194	3	3	56
-159.1833	-2.778554	50.45654	0.194	3	3	57
-159.1833	-2.778554	53.61007	0.194	3	3	58
-159.1833	-2.778554	56.7636	0.194	3	3	59
-159.1833	-2.778554	59.91714	0.194	3	0	60

Sources: 3
Pulse No., Voltage Magnitude, Phase (Degrees): 1, 701.3, -92.6
Pulse No., Voltage Magnitude, Phase (Degrees): 21, 325.5, -71.9
Pulse No., Voltage Magnitude, Phase (Degrees): 41, 402.3, -123.1

Number of Loads: 0

```
********************    SOURCE DATA     ********************
Pulse  1       Voltage = (-32.2933, -700.5096j)
               Current = (-3.9715, -1.5447j)
               Impedance = (66.654, 150.46j)
               Power = 605.18 Watts

Pulse  21      Voltage = (101.0512, -309.4302j)
               Current = (6.4884, 0.1646j)
               Impedance = (14.355, -48.054j)
               Power = 302.37 Watts

Pulse  41      Voltage = (-219.5244, -337.1375j)
               Current = (-3.1338, 1.4921j)
               Impedance = (15.349, 114.889j)
               Power = 92.45 Watts

Total Power = 1000.000 Watts

********************    CURRENT DATA    ********************

Wire No.  1 :
```

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
1	-3.9715	-1.5447	4.2613	-158.7459
2	-4.3608	-1.5215	4.6187	-160.7658
3	-4.5773	-1.4958	4.8155	-161.9033
4	-4.7221	-1.463	4.9436	-162.7861
5	-4.8074	-1.4227	5.0135	-163.5141
6	-4.8386	-1.375	5.0301	-164.1356
7	-4.8184	-1.3201	4.9959	-164.6783
8	-4.7488	-1.2582	4.9127	-165.1602
9	-4.6317	-1.1898	4.7821	-165.5938
10	-4.4687	-1.1151	4.6057	-165.9883
11	-4.2614	-1.0348	4.3852	-166.3505
12	-4.0117	-0.9494	4.1225	-166.6858
13	-3.7214	-0.8592	3.8193	-166.9986
14	-3.3925	-0.765	3.4777	-167.2924
15	-3.0271	-0.6672	3.0997	-167.5702
16	-2.6267	-0.5663	2.6871	-167.8343
17	-2.193	-0.4626	2.2412	-168.0872
18	-1.7261	-0.3565	1.7625	-168.3307
19	-1.224	-0.2475	1.2487	-168.5672
20	-0.6778	-0.1342	0.691	-168.801
E	0.0	0.0	0.0	0.0

Wire No. 2 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
21	6.4884	0.1646	6.4905	1.453
22	6.3274	0.117	6.3284	1.0598
23	6.1925	0.0882	6.1932	0.8162
24	6.0411	0.064	6.0414	0.6073
25	5.8688	0.0431	5.869	0.4207
26	5.6743	0.0248	5.6743	0.25
27	5.4568	0.0087	5.4568	0.0915
28	5.2164	-0.0052	5.2164	-0.0569
29	4.9533	-0.017	4.9533	-0.197
30	4.668	-0.0269	4.6681	-0.33
31	4.3609	-0.0348	4.361	-0.457
32	4.0327	-0.0407	4.0329	-0.5787
33	3.6839	-0.0447	3.6841	-0.6959
34	3.315	-0.0468	3.3153	-0.8092
35	2.9264	-0.0469	2.9268	-0.919
36	2.5182	-0.0451	2.5186	-1.0258
37	2.0899	-0.0412	2.0903	-1.1302
38	1.6398	-0.0353	1.6402	-1.2327
39	1.1637	-0.0271	1.164	-1.3339
40	0.6511	-0.0163	0.6513	-1.436
E	0.0	0.0	0.0	0.0

Wire No. 3 :

Pulse No.	Real (Amps)	Imaginary (Amps)	Magnitude (Amps)	Phase (Degrees)
41	-3.1338	1.4921	3.4709	154.5395
42	-3.3171	1.6131	3.6885	154.0661
43	-3.4098	1.6785	3.8006	153.7907
44	-3.4609	1.7201	3.8648	153.572
45	-3.4763	1.7417	3.8882	153.388
46	-3.4587	1.745	3.8739	153.2282
47	-3.4096	1.7308	3.8238	153.0865
48	-3.3304	1.6999	3.7392	152.9589
49	-3.2222	1.6529	3.6214	152.8427
50	-3.0861	1.5904	3.4718	152.7358
51	-2.9232	1.5129	3.2915	152.6367
52	-2.7349	1.421	3.0821	152.5443
53	-2.5225	1.3155	2.8449	152.4575
54	-2.2873	1.197	2.5816	152.3756
55	-2.0306	1.0662	2.2935	152.298
56	-1.7538	0.9237	1.9822	152.2241
57	-1.4576	0.77	1.6485	152.1536
58	-1.1424	0.6052	1.2928	152.0858
59	-0.8068	0.4286	0.9136	152.0204
60	-0.4451	0.2371	0.5043	151.9563
E	0.0	0.0	0.0	0.0

********** BASE OPERATING PARAMETERS **********

Twr.	Ratio	Phase
1	0.657	-160.2
2	1.000	0.0
3	0.535	153.1

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KHNC-1N.CIR

I	4.3931	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	2.3200	2	3	.0000	.0000	.0000
L	630.0000	2	0	.0000	.0000	.0000
R	66.6540	3	0	150.4600	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.360

NODE	VOLT MAG	VOLT PHASE
1	780.2198	69.0091
2	778.6569	69.3109
3	700.7249	66.7942

			BRANCH VOLTAGE		BRANCH CURRENT	FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
			MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
VSWR										
R	1-	2	1.000	4.39	.000	4.39	.000	63.62	165.82	62.62	165.82
L	2-	3	2.320	84.42	90.688	4.26	.688	66.65	170.28	66.65	150.46
L	2-	0	630.000	778.66	69.311	.14	-20.689	.00	5383.43	.00	.00
R	3-	0	66.654	700.72	66.794	4.26	.688	66.65	150.46	.00	.00

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KHNC-2N.CIR

I	6.4905	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	4.6500	2	3	.0000	.0000	.0000
L	630.0000	2	0	.0000	.0000	.0000
R	14.3550	3	0	-48.0540	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.360

NODE	VOLT MAG	VOLT PHASE
1	113.5232	-28.3053
2	107.8527	-29.9405
3	326.0161	-73.2147

			BRANCH VOLTAGE		BRANCH CURRENT	FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
			MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
VSWR										
R	1-	2	1.000	6.49	.000	6.49	.000	15.40	-8.29	14.40	-8.29
L	2-	3	4.650	258.30	90.153	6.50	.153	14.35	-8.32	14.35	-48.05
L	2-	0	630.000	107.85	-29.941	.02	-119.941	.00	5383.43	.00	.00
R	3-	0	14.355	326.02	-73.215	6.50	.153	14.36	-48.05	.00	.00

WESTBERG CIRCUIT ANALYSIS PROGRAM

FILE NAME = KHNC-3N.CIR

I	3.5782	0	1	.0000	.0000	.0000
R	1.0000	1	2	.0000	.0000	.0000
L	3.4300	2	3	.0000	.0000	.0000
L	630.0000	2	0	.0000	.0000	.0000
R	15.3490	3	0	114.8890	.0000	.0000
EX	.0000	0	0	.0000	.0000	.0000

FREQ = 1.360

NODE	VOLT MAG	VOLT PHASE
1	505.7303	83.6800
2	505.3489	84.0832
3	403.9273	82.5495

			BRANCH VOLTAGE		BRANCH CURRENT	FROM NODE IMPEDANCE		TO NODE IMPEDANCE	
			MAG	PHASE	MAG	PHASE	RESISTANCE	REACTANCE	RESISTANCE	REACTANCE
VSWR										
R	1-	2	1.000	3.58	.000	3.58	.000	15.56	140.48	14.56	140.48
L	2-	3	3.430	102.14	90.159	3.48	.159	15.35	144.20	15.35	114.89
L	2-	0	630.000	505.35	84.083	.09	-5.917	.00	5383.43	.00	.00
R	3-	0	15.349	403.93	82.550	3.48	.159	15.35	114.89	.00	.00

Sampling System

The sampling system consists of three identical Delta Electronics current transformers installed at the output of each antenna tuning unit, immediately adjacent to the final J-plug. Samples from the current transformers are fed to the antenna monitor via equal lengths of 3/8-inch foam-dielectric coaxial transmission lines. The antenna monitor is a Potomac Instruments AM19 Type 204.

Impedance measurements were made of the antenna sampling system using an AIM 4170 network analyzer. The measurements were made looking into the antenna monitor ends of the sample lines with the tower ends of the sample lines open-circuited.

The table below shows the frequencies above and below the carrier frequency where resonance, defined as zero reactance corresponding with low resistance, was found. As the length of distortionless transmission line is 180 electrical degrees at the difference frequency between adjacent frequencies of resonance, and frequencies of resonance occur at odd multiples of 90 degrees electrical length, the sample line length at the resonant frequency above carrier frequency, which is the closest one to the carrier frequency, was found to be 270 electrical degrees. The electrical length at carrier frequency appearing in the table below was calculated by ratioing the frequencies.

Twr.	Sample Line Open-Circuited Resonance Below 1360 kHz (kHz)	Sample Line Open-Circuited Resonance Above 1360 kHz (kHz)	Sample Line Calculated Electrical Length At 1360 kHz (deg.)
1	978.4	1473.0	249.8 249.3
2	977.9	1474.7	249.7 249.0
3	977.8	1472.8	249.9 249.3

Because the electrical lengths were found to have a maximum variation between lines of 0.2 electrical degrees, the sample lines meet the requirement in the Rules that they be equal in length within one electrical degree.

To determine the characteristic impedance values of the sample lines, open-circuited measurements were made with frequencies offset to produce ± 45 degrees of electrical length from resonance.

The characteristic impedance was calculated using the following formula, where $R_1 + j X_1$ and $R_2 + j X_2$ are the measured impedances at the +45 and -45 degree offset frequencies, respectively:

$$Z_O = ((R_1^2 + X_1^2)^{1/2} \times (R_2^2 + X_2^2)^{1/2})^{1/2}$$

Twr.	+ 45 Deg. Offset Frequency (kHz)	+45 Deg. Measured Impedance (ohms)	- 45 Deg. Offset Frequency (kHz)	-45 Deg. Measured Impedance (ohms)	Calculated Characteristic Impedance (ohms)
1	1239	4.0 –j48.6	731.1	4.9 –j51.5	50.2
2	1239	4.1 –j48.7	731.1	5.1 –j51.3	49.5
3	1239	4.9 -j47.3	731.1	5.9 –j51.4	49.6

The sample line measured characteristic impedances meet the requirement that they be equal within 2 ohms.

The calibration of the Delta current transformers was verified by removing them all from the ATUs and installing them on a test jig so that each was located very close to the adjacent transformer (spacing of less than two inches). Short transmission lines of equal length were connected between the outputs of the current transformers and the inputs of the antenna monitor. The Potomac AM19 antenna monitor was calibrated using the internal calibration function. A single source of RF current on the carrier frequency was fed through a conductor passing through all of the current transformers, and the differential phases and ratios were noted on the antenna monitor as follows:

Twr.	Serial No.	Ratio	Phase (deg.)
1	15630	1.000	0.0
2	15625	Ref.	Ref.
3	15627	1.000	0.0

The requirement that the sample current transformers are accurate to within the manufacturer's specification (±2% ratio and ±2 degrees phase) has thus been demonstrated.

The impedance of each of the sample lines was measured with the sample current transformers attached. These impedances are tabulated below:

Twr.	R (ohms)	X (ohms)
1	55.0	-j2.0
2	55.5	-j2.3
3	55.0	-j2.0

Direct Measurement of Power

Common point impedance measurements were made using a Delta OIB-1 bridge installed in the j-plug adjacent to the common point ammeter on the common point bus of the phasing and coupling system. The resistance value was adjusted to 50 ohms and the reactance value was adjusted to zero.

Appendix A

Reference Field Strength Measurements

Reference field strength measurements were made on December 30, 2009 using a Potomac Instruments FIM-41 field intensity meter of known calibration at three locations along radials at the azimuths with radiation values specified on the construction permit and, additionally, on the major lobe radial. The measured field strengths and descriptions and NAD-27 GPS coordinates for the reference measurement points are shown in the following tables.

Radial 1.5°

Point No.	Dist. km	Latitude	Longitude	Time	Field mV/m
1	5.64	40-26-13.2	104-54-13.2	1302	81
2	6.74	40-26-48.9	104-54-15.2	1308	61
3	8.80	40-27-55.4	104-54-10.4	1315	53

Radial 71.5°

Point No.	Dist. km	Latitude	Longitude	Time	Field mV/m
1	3.26	40-23-45.7	104-52-09.5	1348	12.8
2	6.64	40-24-21.7	104-49-54.1	1341	6.2
3	7.08	40-24-26.1	104-49-36.3	1337	7.4
4	8.24	40-24-37.2	104-48-48.9	1331	7.8

Radial 131.5°

Point No.	Dist. km	Latitude	Longitude	Time	Field mV/m
1	4.11	40-21-43.0	104-52-09.4	1355	13.6
2	5.16	40-21-22.3	104-51-33.6	1359	10.7
3	8.59	40-20-08.2	104-49-45.3	1409	7.3

Radial 181°

Point No.	Dist. km	Latitude	Longitude	Time	Field mV/m
1	6.23	40-19-49.4	104-54-23.8	1420	44
2	8.21	40-18-45.6	104-54-24.6	1425	38
3	9.90	40-17-50.8	104-54-24.8	1430	31.5

Radial 230°

Point No.	Dist. km	Latitude	Longitude	Time	Field mV/m
1	4.38	40-21-39.0	104-56-41.4	1453	26.3
2	6.36	40-20-56.9	104-57-44.7	1447	15.1
3	8.18	40-20-20.0	104-58-44.9	1442	11.8

Radial 290.5°

Point No.	Dist. km	Latitude	Longitude	Time	Field mV/m
1	3.49	40-23-50.0	104-56-39.1	1500	16.6
2	5.27	40-24-10.4	104-57-49.6	1506	10.2
3	6.10	40-24-19.0	104-58-23.2	1520	10.8
4	6.55	40-24-23.6	104-58-41.3	1513	10.5